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Mössbauer Study of Fe^{57} in FeTi and $\text{Fe}_{.8}\text{Mn}_{.2}\text{Ti}$ Hydrides

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) - This study has been conducted to investigate the effect hydriding has on the electronic and magnetic properties of FeTi and Fe _{.8} Mn _{.2} Ti using the Mössbauer Effect. Experiments were conducted using the 14.4 kev Mössbauer radiation from Fe ⁵⁷ at		

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temperatures between 4.2°K and 298°K . Studies were made of the changes in isomer shift and linewidth upon hydriding. Our results indicate that hydriding FeTi and $\text{Fe}_{.8}\text{Mn}_{.2}\text{Ti}$ causes phase changes in the crystals from an α phase to either a β and/or γ phase. These studies also indicate that although there is a major change in the pressure composition isotherm upon alloying with manganese, there is no change in the electronic structure of the iron.

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STATEMENT OF PROBLEM

This research was a Mössbauer study of FeTi and Fe_{.8}Mn_{.2}Ti and their hydrides. Fe⁵⁷ was used as a probe in studying the metallurgical and electronic structure of the compounds studied. Changes in electronic density were indicated by changes in isomer shift. Experiments were conducted at various temperatures between room temperature and liquid helium (4.2°K). A computer least squares analysis was performed on all spectra to determine the best theoretical fit for all experimental data. An interpretation of the effects of hydrogen absorption in intermetallics was made by comparing X-ray diffraction and Mössbauer spectra before and after hydriding for FeTi and Fe_{.8}Mn_{.2}Ti.

SUMMARY OF RESULTS

X-ray diffraction measurements indicated that $\text{Fe}_{.8}\text{Mn}_{.2}\text{Ti}$ was single phase with the identical pattern found for FeTi. Mössbauer measurements on FeTi gave the same isomer shift within experimental error as found by previous researchers. FeTi and $\text{Fe}_{.8}\text{Mn}_{.2}\text{Ti}$ exhibited a single peak and remained non-magnetic down to 4.2°K . Spectra rendered identical results within experimental error for FeTi and $\text{Fe}_{.8}\text{Mn}_{.2}\text{Ti}$ (See Table 1).

Our results indicate that hydriding FeTi and $\text{Fe}_{.8}\text{Mn}_{.2}\text{Ti}$ causes phase changes in the crystals. These studies indicate that although there is a major change in the pressure composition isotherms upon alloying with manganese, there is no change in the electronic structure of the iron atom as demonstrated by the Mössbauer Effect. There appears to be no correlation between electron structure due to the 3rd element and the hydrogen absorption properties.

Hydriding broadens the linewidth for both compounds. This broadening is attributed to changes in phase of the compounds. There was an increase in the isomer shift. The change represents a decrease in the s-electron density at the nuclear site. A reduction of the electron density may be due to either an increase of d character at the Fe site or an increase in the lattice volume.

Mössbauer measurements on cycled samples showed the compounds to be reversible (see table 2) with fully desorbed samples rendering the same spectra as unhydrided compounds. Cycled samples showed no evidence of ferromagnetic precipitates.

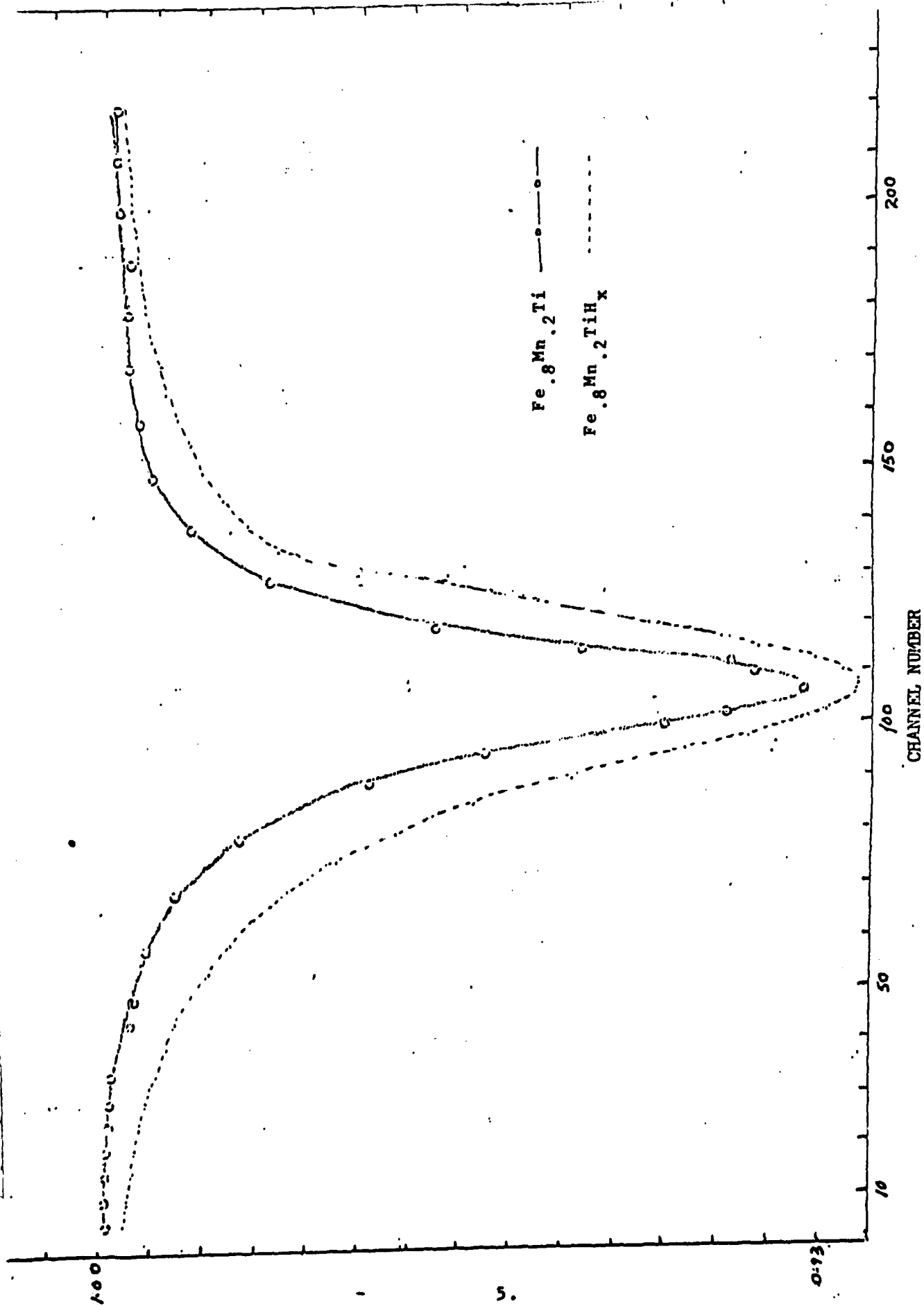
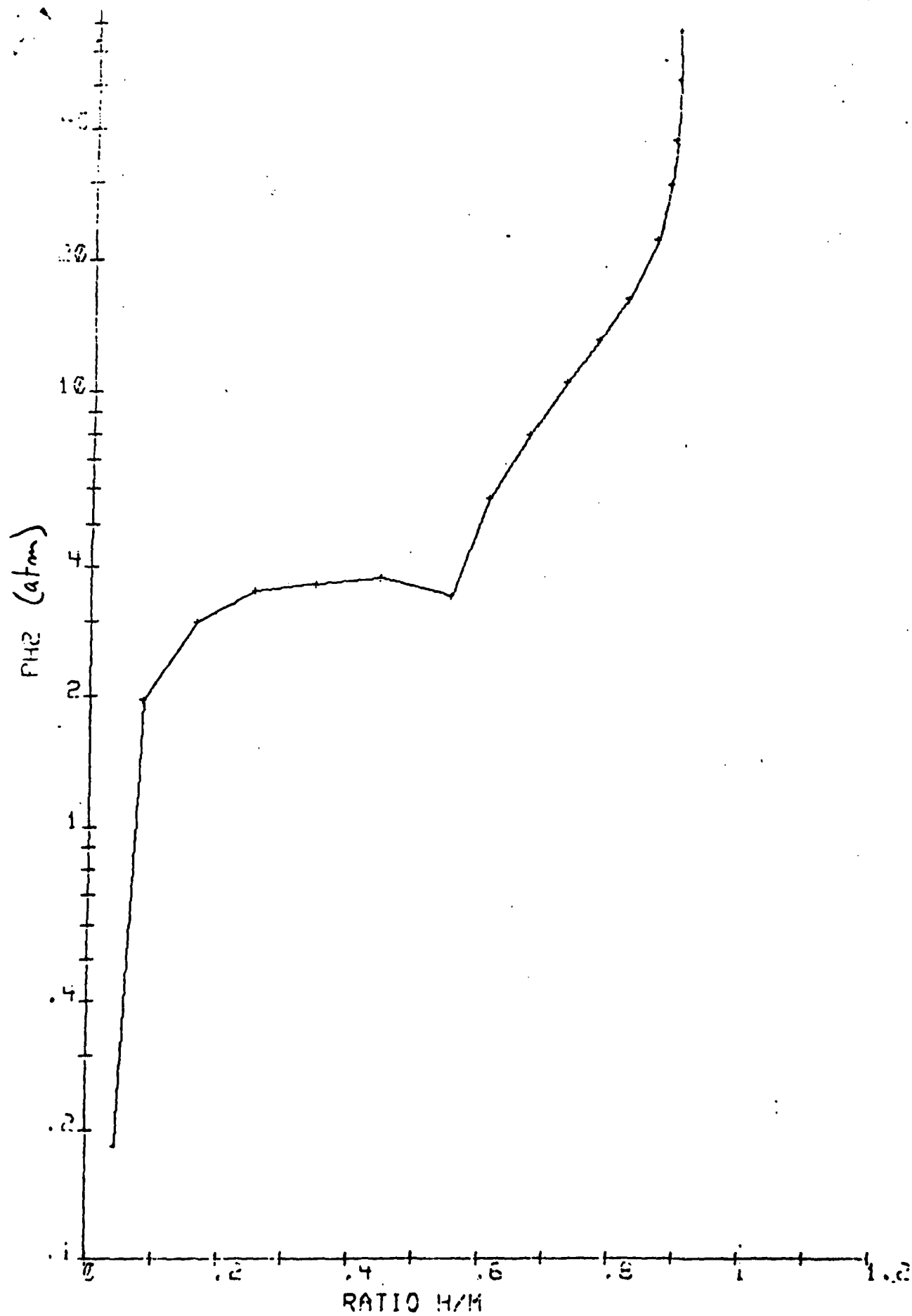
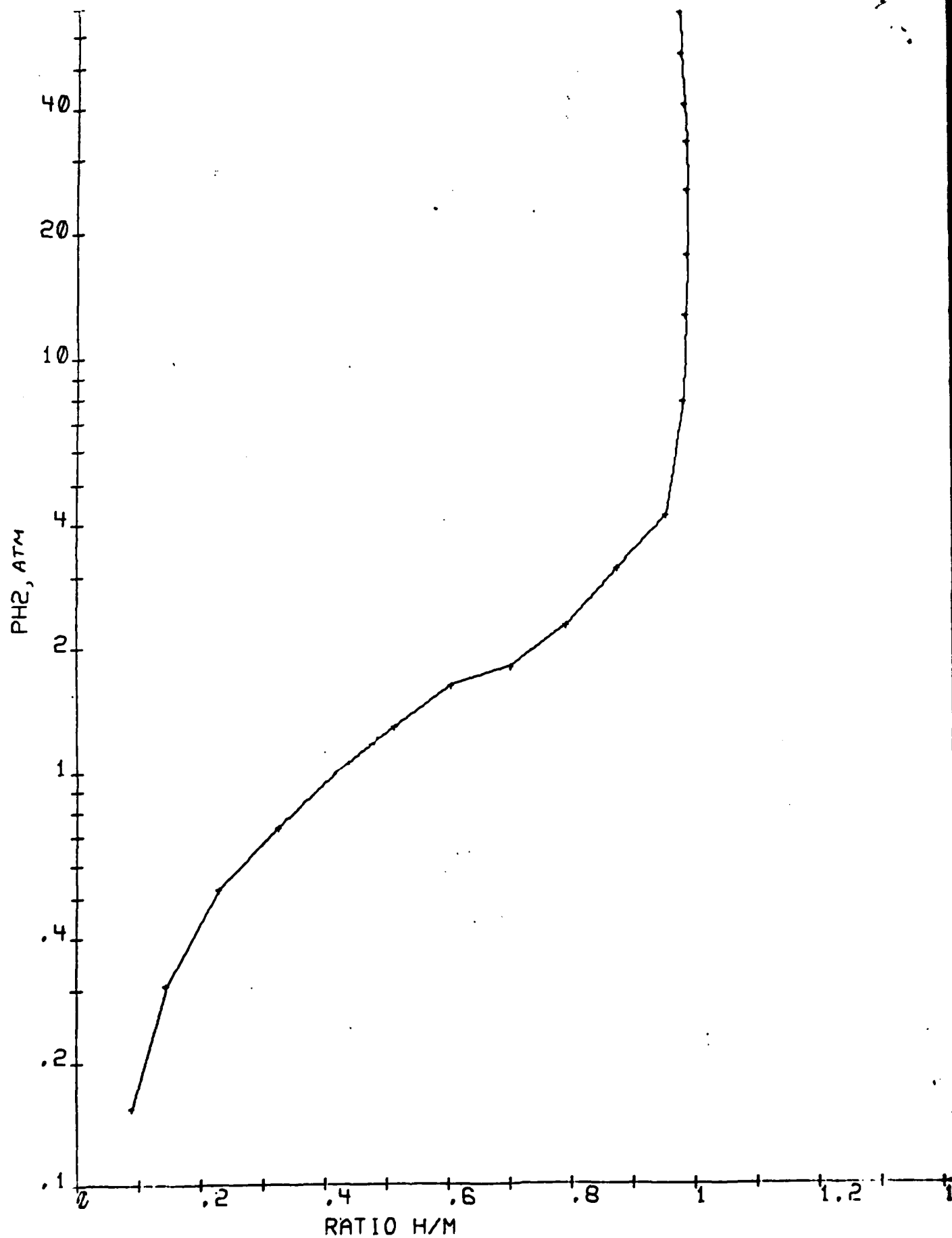


FIG. 1 Mössbauer Spectra of Fe.₈Mn.₂Ti and Fe.₈Mn.₂TiH_x



PRESSURE COMPOSITION ISOTHERM FOR $FeTiH_x$



PRESSURE COMPOSITION ISOTHERM FOR $Fe_{0.8}Mn_{0.2}TiH_x$

<u>SAMPLE</u>	<u>LINEWIDTH (mm/sec)</u>
FeTi	.20 ± .01
FeTiH _x	.26
Fe _{.8} Mn _{.2} Ti	.22
Fe _{.8} Mn _{.2} TiH _x	.25

Table 1. - Comparison of Mössbauer Linewidth for Hydrided FeTi and Fe_{.8}Mn_{.2}Ti.

<u>SAMPLE</u>	<u>ISOMER SHIFT</u>
FeTi	.16 ± .01
Fe _{.8} Mn _{.2} Ti	.15
Fe _{.8} Mn _{.2} TiH _{x-x} (Hydrogen cycled)	.14

Table 2. - Comparison of Mössbauer Isomer Shift Data (295°K)

<u>SAMPLE</u>	<u>TEMPERATURE</u>	<u>ISOMER SHIFT</u>
FeTi	295°K	-0.16 ± 0.01
FeTi	77°K	-0.05
FeTi	4.2°K	-0.03

Table 3. - Comparison of Mössbauer Isomer Shift with Temperature for FeTi.

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Mössbauer Study of Fe in FeTi and $\text{Fe}_{.8}\text{Mn}_{.2}\text{Ti}$

Master of Science - Kim Fraunfelker
Mössbauer Effect Study of $\text{TiFe}_{.8}\text{Mn}_{.2}\text{H}_x$

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